Salts and their Reactions. By Dr. L. Dobbie and H. Marshall. Pp. 198. (Edinburgh: James Thin, 1904.) Price 3*s.* 6*d.* net.

THIS book is intended to serve as an introduction to the study of practical chemistry, and has for its basis a series of notes intended for use in the Edinburgh classes. In an interesting preface Prof. Crum Brown states his belief in the possibility of devising a course that would be "something better than a mechanical training to enable students to pass a mechanical examination consisting in the detection of simple salts in solution." Notwithstanding this assurance, one finds that about half the book consists of descriptions of the ordinary tests and schemes of analysis common to most books treating of elementary practical chemistry.

The first part of the work consists of a short and very clear account of the general physical properties of salts and salt solutions. An outline is given of the ionisation hypothesis and of its applications, some of which are practically illustrated at a later stage. After a short account of the nature and use of indicators, a chapter is devoted to alkalimetry and acidimetry. The experimental part of the book, excluding the sections on qualitative analysis, is only represented by about twenty-five pages, and although the selection of experiments has evidently been carefully made, it seems a pity that the practical illustration of a really excellent theoretical introduction should be so meagre.

The remainder of the book is taken up with a description of the reactions of metallic and salt radicals, and with schemes for analysis. In several small particulars a departure from the conventional methods has been made with distinct advantage. Dry-way reactions, which so few chemists appear to appreciate, are relegated to an appendix, which also contains the inevitable and perfectly useless description of the reactions of the so-called rare elements. Teachers who have the management of large practical classes should find the volume of value.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radiation Pressure.

ON p. 515 of your issue of September 22 I stated that there is a retarding force on the earth as it moves along its orbit amounting in all to about 20 kgm. The calculation was made on the supposition that the earth is a full radiator of uniform temperature. I have found on revising the calculation that there was an error in the arithmetic, and that the force is considerably greater, though still too small to have an effect worth considering. The following is a simple method of obtaining its value. It assumes that the earth may be treated as a black sphere exposed to sunlight, radiating as much as it receives, and with all its surface at one temperature.

If the stream of solar energy falling normally on 1 sq. cm. is S per second, a black sphere, radius a, receives πa^2S per second. If it radiates R per second per sq. cm. its total radiation is $4\pi a^2$R, and the assumption of equal receipt and expenditure gives R=S/4. The total repulsive force exerted by the sun's radiation is $S\pi a^2/U$, where U is the velocity of light. The total retarding force due to velocity u in the orbit is $4/3\ Ru/U^2.\pi a^2$. This is the Doppler effect due to crowding of energy in front and opening out behind (*Phil. Trans.*, A, ccii. p. 546, corrected by final note). Hence we have

$$\frac{\text{Retarding force}}{\text{Solar repulsion}}=\frac{u}{3U}.$$

At the earth's distance u/U is about 10^{-4}, so that the retarding force is about 1/30,000 of the solar repulsion.

If we take S/U as $5{\cdot}8\times10^{-5}$ dyne/sq. cm. (*Phil. Trans., loc. cit.*, p. 539), and the radius of the earth as $6{\cdot}37\times10^8$ cm., the total solar repulsion is about 75×10^6 kgm., say 75,000 tons, and the retarding force is about 2500 kgm.

But another effect comes in which will more than counterbalance this. The hemisphere of the earth which is advancing in the orbit is on the whole colder than that which is retreating, owing to the lag in the warming of the surface exposed to the sun. I find that if one hemisphere is at 301° A. and the other at 300° A., the greater radiation from the warmer side gives a net push directed from that side to the colder of about 165,000 kgm. Of course this hemispherical distribution of temperature is only a rough approximation to the real condition, and even if the force be as large as 165,000 kgm. only a component of it acts along the orbit tending to accelerate the motion. Still, that component must almost certainly be much greater than the retarding force due to the Doppler effect, and on the whole, therefore, there is probably a small acceleration in the orbit. A force of 2500 kgm. would destroy about $4/10^{18}$ of the earth's momentum in one year. Even if the accelerating force were twenty-five times as great as this it would only generate $1/10^{16}$ of the present momentum in one year. This illustrates the insignificance of radiation pressure on the larger bodies in the solar system.

I take this opportunity of correcting another error in the address in NATURE of September 22, which has been pointed out to me by Mr. C. T. Whitmell. It arose from some very faulty arithmetic on p. 541 of the paper in the *Philosophical Transactions* already referred to. Apparently in the formula giving the radius of each of two equal spheres the mutual radiation-repulsion of which balances their gravitative attraction, a square root of 10 was omitted, and the value of that radius should be $a=0{\cdot}69\theta^2/10^4\rho$. A wrong value was also assigned to the density of the sun. Mr. Whitmell has very kindly re-calculated the results depending on this formula, and I have worked them out independently. We now find that two equal spheres will have equal radiation-repulsion, and gravitative attraction with radii as given below:—

Temperature absolute		Density		Radius in centimetres
6200°	...	1·375	...	1930
300	...	1	...	6·1
300	...	11	...	0·5645
300	...	5·5	...	1·13

The last was given previously as 3·4 cm.

The effect of radiation pressure on terrestrial dust is worthy of consideration, for it may be quite appreciable when the particles are small and are among surroundings at different temperatures. For simplicity of calculation, let us suppose a very small dust particle, of density ρ, to be cylindrical with radius a and length a, and let its flat ends be black and let its curved surface be perfectly reflecting. Let it be situated between two indefinitely extended parallel vertical walls, one at a temperature θ_1° A., the other at a lower temperature θ_2° A., and let its ends be parallel to the walls. The two faces of the dust particle will, if it is small enough, be at very nearly the same temperature, so that we may leave out of account the pressures due to the emitted radiation and consider only those due to that received from the walls. If σ is the radiation constant $5{\cdot}32\times10^{-5}$, and if U is the velocity of light, the difference of pressure on the two sides will be $2\sigma(\theta_1^4-\theta_2^4)/3U$, and the acceleration due to this on area πa^2 and mass $\rho\pi a^3$ is $2\sigma(\theta_1^4-\theta_2^4)/3U\rho a$. When $\rho=1$, $a=10^{-3}$, $\theta_1=400°$ A., $\theta_2=300°$ A., this acceleration is 0·02 cm./sec.^{2}.

If the law of radiation pressure can be taken as still holding when the radius is reduced to $a=10^{-5}$, the acceleration is 2 cm./sec.^{2}. This implies that such a particle of dust, in a vacuum, and between vertical walls respectively at 27° C. and 127° C. would not fall vertically, but would deviate about 2 mm. per metre towards the colder wall.

The effect found by Prof. Osborne Reynolds (*Phil. Trans.*, ii., 1879, p. 770) on a silk fibre exposed to radiation from a hot body, and assigned by him to "radiometer" action, is far larger than this. The radius of the fibre was 0·000625 cm., and its length was probably about 15 cm. When it was hung up in a test tube containing hydrogen at atmospheric pressure, and was exposed to radiation from a neighbouring jar filled with boiling water, the lower end of the fibre moved through 0·01 cm. This would imply an acceleration of about 0·7 cm./sec.^{2}, about sixty times the acceleration on a dust particle of the same radius under the conditions assumed above. The action detected by Reynolds increased, too, very rapidly as the pressure fell, being ten times as great when the pressure was reduced to 1 inch of mercury.

J. H. Poynting.

The University, Birmingham, December 15.

The Date of Easter in 1905.

Already queries have been addressed to me on the subject of the date of Easter in 1905, owing to the fact that, according to the almanacs, the moon is full at 4h. 56m. Greenwich mean time on the morning of March 21 next, and that therefore, according to the Prayer Book rule, it would appear that Easter Day should be the Sunday following March 21, viz. March 26. As the misunderstanding on the subject seems widely spread, perhaps you will allow me to explain that the "moon" referred to in the ecclesiastical calendar is not the actual moon in the sky, which is full at a definite instant of time, but a fictitious moon, the times of the phases of which are so arranged as not to differ much from those of the actual moon. These phases are held to occur, vaguely, on certain days, and therefore hold good for all longitudes, and so avoid a practical inconvenience that would arise from the use of the actual moon. Thus, in the instance before us, in which the actual moon is full at 4h. 56m. a.m. Greenwich mean time, the same moon is full at 11h. 48m. p.m. (*on the preceding day*) Washington mean time. The people adopting Greenwich time would, therefore, in the supposed circumstances, keep Easter Day on March 26, whilst those adopting Washington time would keep it on April 23.

Perhaps the simplest expression for the date of the Paschal full moon is March (44 − epact), which gives the date directly when the epact is less than 24. When the epact is equal to or greater than 24, this expression gives the date of the preceding full moon, and the Paschal full moon is found by adding 29 to this date.

Thus in 1905 the epact is 24, therefore the calendar moon is full on March 20, and again on April 18. The latter is, by the rule, the Paschal full moon, and Easter Day is the following Sunday, viz. April 23.

A. M. W. Downing.

H.M. Nautical Almanac Office.

Lepidocarpon and the Gymnosperms.

The concluding sentence in your note on Mr. H. E. H. Smedley's admirable models of the fructifications of Palæozoic plants (Nature, December 22, p. 183) may possibly be misleading to some of your readers. As the models of Lepidocarpon shown in your figure were prepared from my instructions, I may be supposed to share the responsibility for the hypothesis of an affinity between the lycopodiaceous cones and the Gymnosperms, stated to have been urged by "the author," especially as the points of agreement mentioned are quoted, with some slight abridgment, from my paper on the seed-like fructification of Lepidocarpon in the *Philosophical Transactions*.[1] Such an affinity has never appeared to me to be probable. The characters cited—the presence of an integument and micropyle, the single functional megaspore, and the detachment of the indehiscent, seed-like organ as a whole—are important points of analogy with true seeds, but in Lepidocarpon "these organs differ too much in detail from the seeds of Gymnosperms to afford any evidence of affinity."[1] I doubt whether my friend Mr. Smedley really intended to suggest anything more than an analogy.

As regards the Gymnosperms, evidence has been accumulating for some time past indicating their connection with the fern-phylum rather than with the Lycopods. Some account of this evidence will be found in my discourse at the Royal Institution on the origin of seed-bearing plants (1903),[2] while a more recent summary is given in Mr. Arber's article on Palæozoic seed-plants in Nature for November 17, p. 68.

The seed-like organs of some Palæozoic Lycopods, such as Lepidocarpon and Miadesmia,[3] seem to be cases of homoplastic modification, and not to be indicative of any affinity with those groups of seed-plants which have come down to our own day.

D. H. Scott.

Jodrell Laboratory, Kew.

[1] *Phil. Trans.* R.S., Series B, vol. cxciv., 1901, p. 320. See also Nature, vol. lxiii., 1900–1901, pp. 122 and 506.

[1] *Phil. Trans.*, *loc. cit*, p. 324.

[2] Nature, vol. lxviii., p. 377.

[3] Miss M. Benson, "A New Lycopodiaceous Seed-like Organ," *New Phytologist*, vol. i., 1902, p. 58.

Fishing at Night.

The notice in your Journal of the "Sea Fishing Industry," written by Mr. Aflalo, suggests to me that he or some other of your readers may inform me why sea fishing takes place for the most part at night. I have heard the subject discussed all my life, and the answers have been of the most opposite and unsatisfactory character, such as to obtain a supply of fish for the morning markets, and because fish come nearer to the surface in the dark. Everyone must be familiar with the sight of our fishing boats preparing to take their departure as the evening approaches in the different harbours on our coasts. Some of the masters, unfortunately, like the Apostle Peter, have toiled all night and caught nothing.

S. W.

December 20.

A New British Bird!

A fine example, a male, of the Pacific eider-duck, *Somateria v-nigrum,* was killed at Scarborough on December 16. This is the first recorded instance of the occurrence of the bird on our shores. Closely resembling the common eider, *Somateria molissima,* it may yet be readily distinguished therefrom by the bright orange colour of the bill, and the sharply defined, black V-shaped mark on the throat—hence the specific name *v-nigrum.*

The Pacific eider occurs in abundance along the coasts of north-western America and north-eastern Asia.

W. P. Pycraft.

Natural History Museum, South Kensington.

Intelligence of Animals.

In reference to the question of intelligence in animals, it may be of interest to mention a case of distinct reasoning power in a cat which for nine or ten years associated himself with our family; he would have scorned the suggestion that he belonged to it. When he found himself on the wrong side of a closed door—a very constant occurrence—he stood up and, catching the handle in his fore paws, *rattled* it. I do not think he tried to *turn* the handle, but he certainly knew that it played an essential part in the opening of the door. He is now no more, and *de mortuis nil nisi bonum* bars any further reference to his career, for he was a dissipated old scoundrel; but it is a pleasure to me to pay, with your permission, the above little tribute to his memory.

Greenock, December 17. T. S. Patterson.